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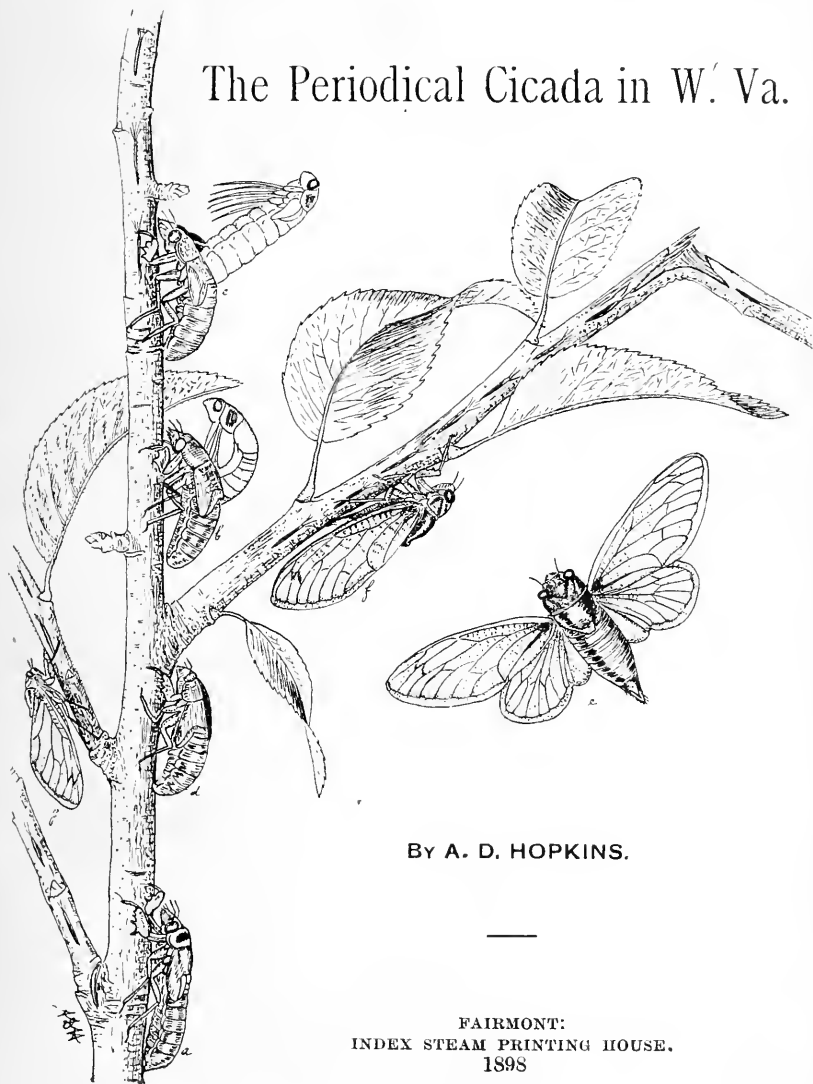
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WEST VIRGINIA
AGRICULTURAL EXPERIMENT STATION,
MORGANTOWN, W. VA.

BULLETIN 50.

JANUARY, 1898.

The Periodical Cicada in W. Va.



By A. D. HOPKINS.

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1898

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WEST VIRGINIA AGRICULTURAL EXPERIMENT STATION.

BULLETIN 50.

VOL. V.

January, 1898.

No. 1.

THE PERIODICAL CICADA IN WEST VIRGINIA.

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PHOTOES BY W. E. RUMSEY.

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THE SEVENTEEN-YEAR LOCUST OR PERIODICAL CICADA IN WEST VIRGINIA.

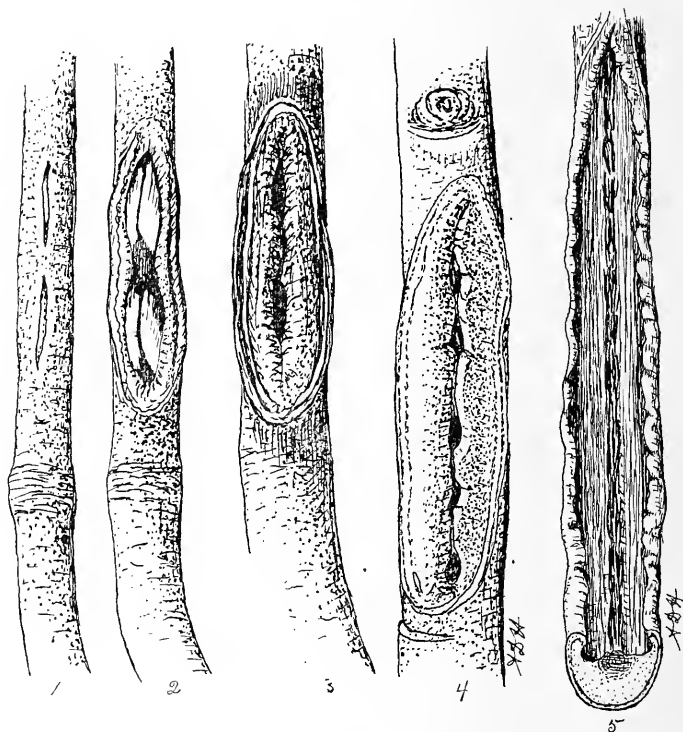
BY A. D. HOPKINS.

There is probably no insect that has attracted more general interest and attention in this country than has the periodical cicada, or the so-called seventeen-year locust. The earliest settlers doubtless associated its vast noisy swarms with the devastating invasions of the migratory locust of the East. Hence, the popular name *locust* which has been used so long that it is doubtful if it will ever be entirely discarded for the proper name *periodical cicada*. Its appearance at long intervals was the cause of much wonder and alarm among the early settlers, and many superstitious and erroneous beliefs prevailed in the minds of the people with reference to its habits and mission, until within the last half century, when something definite began to be learned with reference to its true habits, life history, and distribution.

Since the species was first described by Linnaeus in 1767, it has been the subject of special study by the leading entomologists of the country, and published accounts of what had been learned at the various dates of their publications may be found in Harris's *Insects Injurious to Vegetation*, 1852; Fitch's 1st Report on the Insects of N. Y., 1856; Riley's 1st Report on the Insects of Mo., 1868. Bulletin 8 of the Division of Ent., U. S. Dept. of Agr., May, 1885; and the Report of the U. S. Dept. of Agr., for 1885. Considerable additional information has been published from time to time by different State and Station entomologists and by the Division of Entomology of the U. S. Dept. of Agriculture.

Thus, a mass of information has accumulated with reference to the habits, life history, geographical distribution, and other interesting features of this remarkable insect.

During the month of June each female cicada deposits three to five hundred eggs in numerous ragged punctures made by her powerful ovipositor in the twigs of shrubs and trees, and sometimes in the stems of herbaceous plants. These hatch in

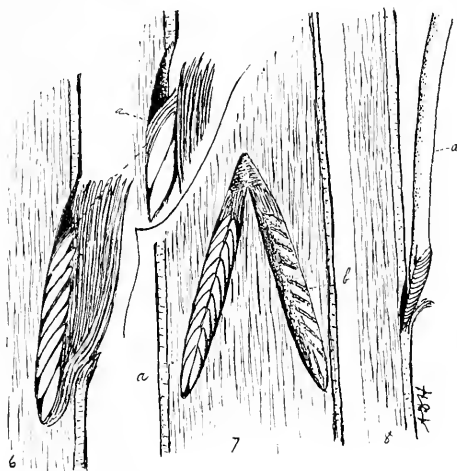


Wounds in apple twigs made by female cicada when ovipositing.

- 1—Fresh wounds where eggs have been deposited. 2—Condition of same three months later. 3—Condition of same one to four years later. 4—Condition four to seventeen years later. The change in the condition depends on whether the wounded twig is making a slow or rapid growth. 5—Wound seventeen years old, prevented from healing by slow growth of twig which was in the top of an old apple tree. Evidence is also found that the wound had been aggravated by the woolly aphid. (Sketched from specimen collected January, 1898.)

about six to eight weeks from the time they are deposited, and the young cicada larvae emerge from the twigs and fall to the ground. They then burrow beneath the surface and enter upon their long and menial existence in the ground, feeding on

the liquids of roots and possibly subsisting on such nutriment as can be obtained from the soil itself. They change their position from time to time, and may enter the earth for a distance of eight or ten feet, or more. During the spring of the fifteenth and sixteenth years, great numbers of the full grown young (as was observed near the Experiment Station in April, 1895 and 1896,) may be found near the surface, and a few individuals may emerge during May and June of the sixteenth year and



Egg cavities showing arrangement of eggs.

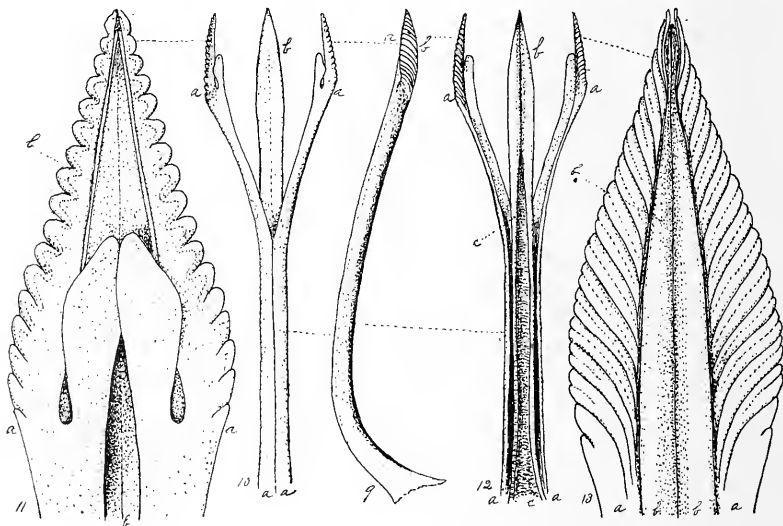
6—Side view *a* showing how the entrance to the cavity is closed with wood fibers.

7—Pair of cavities with fiber covering removed, showing arrangement of eggs in double row at *a*, and empty cavity showing partitions between eggs at *b*

8—Showing position of ovipositor (Fig. 13) in process of excavating cavity.

change to the winged or adult forms. Early in April of the 17th year, the pupae commence to make preparations to emerge from the ground by excavating burrows or exit galleries to the surface. These exits are completed by the last week in April. Ordinarily they only extend to the surface and are kept open from a depth of a few inches to a foot or more, but in some soils these exit holes are extended four or five inches above the

surface by means of clay carried up from the subsoil. The pupae (Plate I, a) come from the ground in the evening and at night, usually between sundown and ten o'clock, and proceed to the nearest upright object, which may be a tree, the



Detail drawings of ovipositor of female periodical cicada.

9, ovipositor from side.

a, lower or ventral part of tip which comes in contact with the wood.

10, ovipositor from below, with outer parts separated to show position of inner lancet, b, through which the eggs pass and are placed by it in position. 11, lancet tip of ovipositor from below, showing special arrangement of point and edges for gouging out the cavity. aa, outer pair of lancets. b, inner lancet.

12, ovipositor from above. aa, outer parts which together form a sheath for the inner lancet tube showing corrugated trough-like groove through which the eggs pass to tip. 13, lancet tip of ovipositor from above, showing special arrangement for adjusting the wood fibers and forming the egg cavity. aa, outer pair of lancets. bb, inner lancet.

Figs. 9, 10, 12 are enlarged a little more than 6 times; 11 and 13 are enlarged about 33 times.

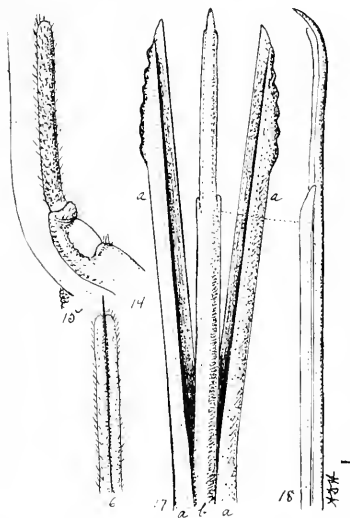
side of a building, fence, post, or weed stem, anything in fact upon which they can climb and expose their bodies to the action of the open air. In about an hour after emerging the skin on the back splits open and the adult insect works its way out. (Plate I, b-c) The wings which are short and soft at first, rap-



PLATE I.—THE PERIODICAL CICADA, (*Cicada septendecim*.)

a, pupa; *b*, pupa with back split open and adult coming out; *c*, the same with adult almost out; *d*, empty pupa shell; *e*, adult wings spread; *f*, adult female in act of ovipositing; *g*, dwarf variety, showing comparative size. All about two-thirds natural sizes. (*b* and *c* after Riley)

idly develop, and the body, wings and legs harden, and by the following day it is ready to take its flight and enter upon its short aerial life, which is limited to about thirty days. During this short period of its existence, in its winged or adult stage, it feeds but little if at all, the males devoting their time during the day to flying about and making a noise, while the voiceless females busy themselves depositing eggs.



14-18, Mouthparts of adult periodical cicada, enlarged about $3\frac{1}{2}$ times. 14, beak or proboscis from side. 15 Piercing and sucking part which fits in a groove in the front of the proboscis as shown in 16. 17, tip of piercers from above, enlarged about 66 times, to show form of lancets *a* which together serve as a sheath for the inner part *b*, which appears to correspond to a tongue. 18, tongue from side.

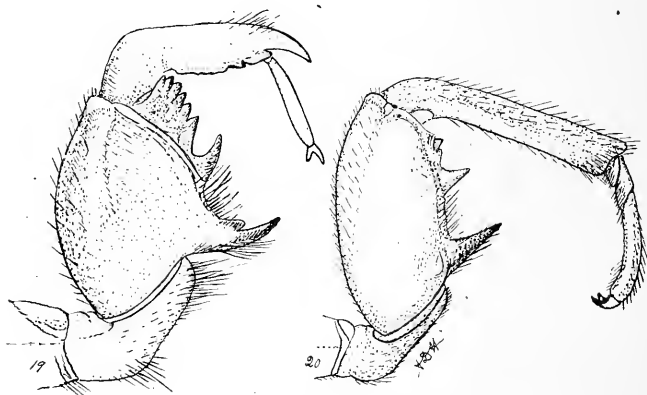
A SEVENTEEN YEAR AND A THIRTEEN YEAR RACE.

In the southern or warmer sections of the U. S., the broods or swarms of the insect appear at regular periods of thirteen years, while in northern or colder sections, they appear every seventeen years. Thus the broods of the former are referred to as belonging to a thirteen year race; while those of the latter belong to a seventeen year race.

TWO DISTINCT FORMS OF THE ADULT.

Two distinct forms or varieties of the insect occur in all

broods or swarms of both the thirteen year and seventeen year races, which are easily distinguished by the difference in size, and in the sound produced by the males. The larger variety (Plate I, e and f) which is the typical form of the species is always more abundant and produces the familiar f-a-r-r-o sound, while the other (Plate I, g) is much smaller and its note is more shrill and quite different from that of its larger brother.



Front legs of periodical cicada: 19, front legs of pupa: 20, front leg of adult female, enlarged $3\frac{1}{2}$ times.

DISTRIBUTION AND NUMBER OF BROODS.

The species appears to be confined in its natural distribution to the United States and to occur in all of the States east of the Rocky Mountains, except Maine, New Hampshire and Vermont. Within the area occupied by it there is, according to Dr. C. V. Riley, over twenty distinct broods, of which seven or eight belong to the 13 year race and thirteen or fourteen to the 17 year race. It has also been determined that there is such a diversity in the areas occupied by each brood and the years in which swarms of the different broods occur, that the insect appears somewhere in the United States nearly every year.

THE DIFFERENT BROODS DESIGNATED BY ROMAN NUMBERS.

In 1868, the late Dr. C. V. Riley, then State entomologist of Missouri, designated all of the broods known, or supposed to

occur in the United States, by Roman numerals, commencing with the one that was to appear in 1869, and numbering consecutively those of both the thirteen and seventeen year races, which, according to previous records, were to appear in subsequent years. Of the twenty-two broods thus numbered, all but one or two were subsequently recorded.

ENEMIES OF THE INSECT.

The insect has numerous enemies which attack it during all stages of its existence, but more especially during that of the fully developed young and adult. Before it leaves the ground it is devoured by hogs and other animals, and killed by diseases. From the time they leave the ground until their mission as adults is ended, they are almost continually assailed, night and day, by parasitic and predaceous insects and other animal life; also by a fungus disease which in damp or rainy weather often takes the character of an epidemic, and kills them by the thousands.

THE ENGLISH SPARROW ONE OF ITS WORST ENEMIES.

During recent occurrences of the broods in the Eastern States it was observed by entomologists that the English sparrow was exterminating the cicada in and near the large cities and towns. Hence, we have at least one redeeming trait of this much abused bird.

INJURIES CAUSED BY THE CICADA.

The piercing of the roots of trees and other plants by the young of this insect, for the purpose of obtaining the sap as food, may do some harm, but it is believed that the injury thus caused is rarely perceptible. The adult females, however, are capable of causing serious injury to young fruit trees in orchards and nurseries by the numerous punctures in the twigs, limbs, and main stems made by them in the act of ovipositing. (See Figs. 1-5 and Plate II.) In fact, young orchards are often ruined and the aggregate loss thus occasioned to fruit grow-

ers and nurserymen reaches many thousands of dollars each "locust year."¹

REMEDIES AND PREVENTIVES.

It appears that no practical method of destroying the insect has been discovered, but with a knowledge of the years in which swarms or broods of the insect will appear in a given locality, the losses from their attacks on young orchards can be reduced to a minimum simply by not planting young trees or shrubs during the two years previous or the spring of the one in which the locust is to appear. Therefore a knowledge of the number of broods, the years in which they will appear, and the exact area covered by each in a given State or county, is of prime importance.

NUMBER OF BROODS IN WEST VIRGINIA.

Up to the year 1897, five broods of the seventeen year race had been recorded from West Virginia, in the publications previously referred to, but very little had been published with reference to the areas occupied by each, except the one which appeared in 1885 in the eastern panhandle.

The appearance of a brood during May and June of the present year (1897), over a large part of the State, offered an excellent opportunity for the entomologist of the Experiment Station to obtain information with reference to the area occupied by this and other broods. Therefore some four hundred reply postal cards were mailed to correspondents and postmasters in all sections of the State, bearing the following request :

"Will you kindly inform us, on the accompanying card, whether or not the seventeen-year locust appeared in the vicinity of your post-office, this year? By so doing, you will enable us to render valuable services to the fruit industry of the State."

Replies to this request were received from over three hundred post-offices, and when they were classified, it was found

¹ Since the above was written I have determined that the injury to old trees is often very serious and here is found an element of loss which heretofore has evidently been overlooked.

that every county in the State had been heard from ; also that a large amount of valuable information had been gathered.

EIGHT BROODS IN WEST VIRGINIA.

From the information obtained from correspondence and personal inquiry, it appears that we have eight instead of five broods in the State, the three additional broods having been quite definitely recorded by a number of reliable correspondents. Thus, in addition to the 1897 swarm of brood XV, the years in which a swarm of each of the other seven broods will probably appear are as follows :

Brood XVII in 1898; brood XX in 1900; brood XXI in 1901; brood XXII in 1902; brood V in 1905; brood VIII in 1906; brood XI in 1910.

HISTORY AND DISTRIBUTION OF THE DIFFERENT BROODS THAT OCCUR IN THE STATE.

In the following pages we will endeavor from the information at hand to give a brief history of the different broods that appear in the State, and to show by means of a map, the approximate areas occupied by each.

BROOD XV, 1880-1897.

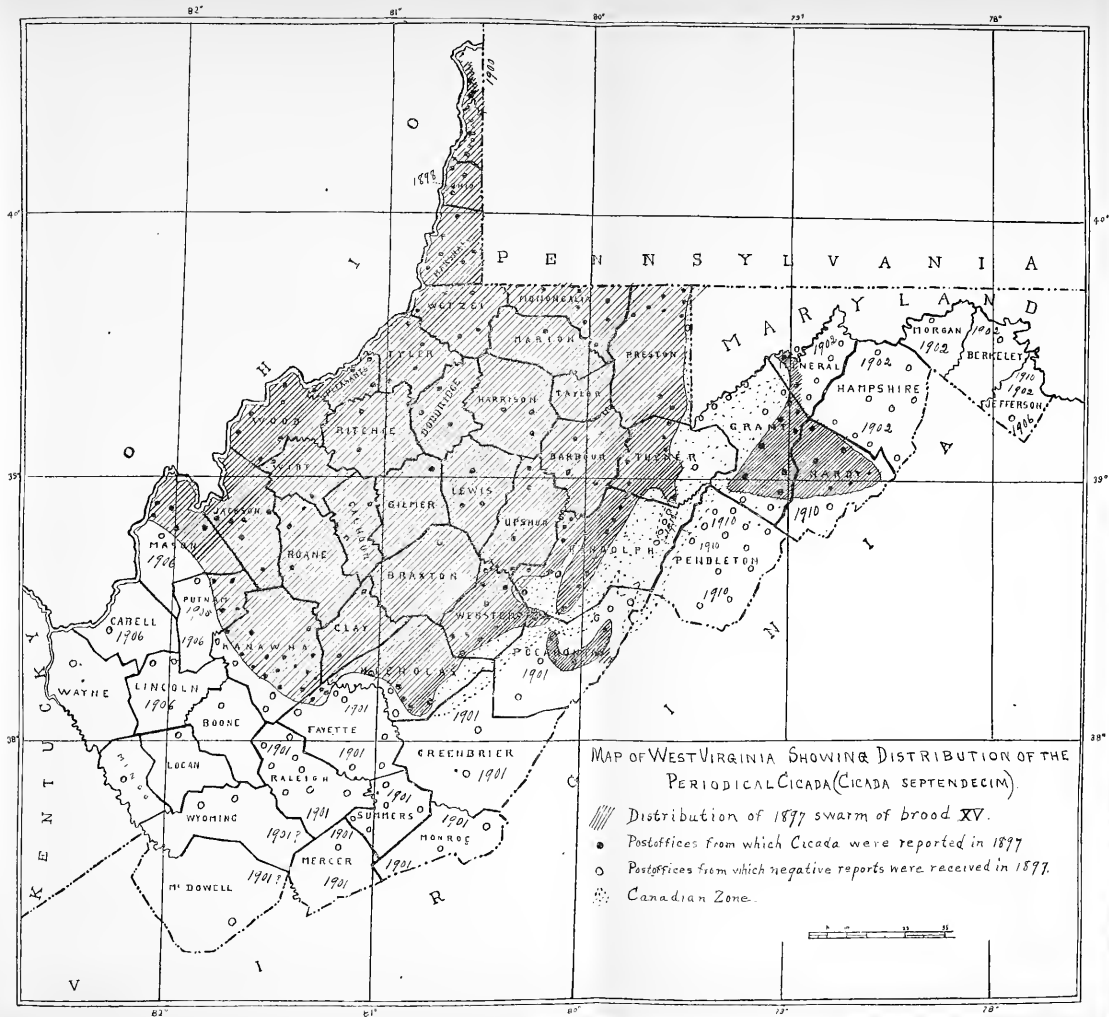
This brood might be properly referred to as the West Virginia brood, since it was first recorded from Lewis county, Virginia, now West Virginia, in 1795. It also occupies by far a larger area of the State than does any of the other broods.

It also extends into Ohio, the southwestern corner of Pennsylvania, and probably into Virginia from Hardy and Pocahontas counties. The records show that this brood has appeared in the State at regular intervals of seventeen years since it was first recorded in 1795, (see letter from Mr. Haymond on page 20), and that up to the present year it had been recorded from thirteen counties in West Virginia, viz: Barbour, Calhoun, Kanawha, Grant, Hardy, Harrison, Lewis, Marion, Monongalia, Ohio, Preston, Roane and Tucker. To this list of counties I am able to add from authentic information twenty-

four counties, in which the swarm of the present year occurred, as follows: Brooke, Braxton, Clay, Doddridge, Fayette, Gilmer, Hancock, Jackson, Marshall, Mason, Mineral, Nicholas, Pocahontas, Putnam, Pleasants, Ritchie, Randolph, Taylor, Tyler, Upshur, Wetzel, Wirt, Wood, and Webster. Two correspondents from two postoffices in Wayne county reported that they heard the insect, but saw none. Similar statements came from correspondents in Summers, Boone and Greenbrier counties. Negative reports were received from the fourteen remaining counties, in which the brood evidently does not occur to any noticeable extent, and also from seventeen counties which are only partially occupied by the brood. Thus, I am able to show quite accurately on the accompanying map, the area occupied by this brood in West Virginia. The fact that not a single negative report was received from the 124 correspondents within the area indicated on the map, as occupied by the brood, is evidence that the area was pretty thoroughly covered, especially in the wooded portions, although there may have been numerous small sections in which it did not occur in sufficient numbers to attract attention.

A most interesting feature was noticed by a number of correspondents on both sides of the border line of the brood, namely: That up to a certain well-defined limit, it was common to find the insects in enormous numbers, in fact, far more numerous than at any point farther back in the main body, while a few hundred yards in advance, scarcely a single example could be seen or heard. This well-defined limit would sometimes follow the bank of a river, small stream or mountain range, while again it would be found crossing at nearly right angles, broad rivers and high mountain ranges. As for example, the Ohio River at the northern limit of the swarm, near Holliday's cove in Hancock County, at its southwestern limit in Mason County, the main Allegheny range at the heads of the Elk and Valley Rivers and at the western corner of Mineral County. Thus the limit of the range of the brood is quite distinctly marked, and beginning at the mouth of the Great Kanawha River, may be traced as follows:





It follows the northeast bank of the Kanawha to near the mouth of Pocatalico River, where it crosses the Kanawha and extends southeast a few miles back from the river, until it reaches about the Fayette county line where it takes a northeast course and again crosses the Kanawha near the mouth of the Gauley River, which it follows north and then east to the mouth of Hominy Creek; thence south, up the valley of this creek to near the Greenbrier County line. From the valley of this creek to the head of the Valley River, the border line is not very well defined, but doubtless extends northeast along the northwestern slopes of the mountains, between 2,000 and 3,000 feet elevation, to Upper Glade in Webster County where it crosses over to the Elk waters, and follows the valley and main branch of this stream to near the Pocahontas and Randolph County lines, it being recorded from Bungo P. O. in Webster County and Elkwater in Randolph County; then it evidently continues below the 3,000 foot contour across Buffalo Bull Mountain and the ridges between the streams flowing into the Elk River and the head water streams of the Little Kanawha, Buckhannon and Middle Fork Rivers, near Pickens, Star, and Adolph Postoffices; thence along the western slopes of Rich Mountain until it finds a pass, through the 3,000 foot barrier, to the eastern slope which it follows northward to near the head of Valley River at Mingo Flats. Here a barrier of 3,300 feet elevation is met with, over which at some time, examples of this brood must have succeeded in passing,¹ since we find a detached section of the brood forming a narrow belt about three miles wide extending from Edra (which is at or near 3,000 feet elevation) to Marlinton, Huntersville, Sunset, Frost, and probably to Greenbank, Pocahontas County, and may possibly cross the mountains and extend into Highland and Bath Counties, Virginia.

From Mingo Flats the border line extends down the Valley

¹The warm air coming from the south up the Elk, Gauley, and Greenbrier Rivers may have the effect of raising the average temperature at this point, sufficient to bring this high elevation within the transition zone.

River, or along the western slope of Cheat Mountains, into Tucker county, where it extends eastward into the valley of Cheat River, which it follows southward to the mouth of Red creek on Dry Fork at the southern border of the county; thence northward around the southern and western slopes of the Back Bone Mountains to near the Maryland line at Aurora in Preston county, then apparently almost due north, a short distance west of the Maryland line through Preston county to the northeast corner, where it crosses the State line into Pennsylvania.

Another curious feature is found in the eastern panhandle of the State, where a detached section of the brood occupies portions of Mineral, Grant and Hardy counties. Here the boundary lines are even more distinctly marked and accurately determined than those of the main body west of the mountains. It enters the western corner of Mineral county, between Bar num and Harrison on the north fork of the Potomac river, and extends east in what appears to be a narrow strip, through a gap in the main front range of the Allegheny Mountains at a point where the northwestern turnpike crosses; thence, down the eastern slope of the mountains to the New Creek Valley, near Laurel Dale, and up the valley into Grant county where it spreads out and covers the greater part of the county. The western border follows the eastern slope of Allegheny Front southward to near the Pendleton county line, which, according to the postmaster, S. K. Nelson, at Jordan's Run, it did not cross in 1880. From near the western corner of Grant county, the border line extends almost due east, across numerous narrow valleys and mountain ranges, through this and Hardy county to the Virginia line. Then it extends north and west to the Hampshire county line, which follows closely to the New Creek valley, thence northward, over the mountain at the low-gap previously mentioned. This gap in the 3,000 foot barrier is about a mile wide and the elevation is 2,700 feet. This narrow strip doubtless extends into Maryland and possibly connects with a spur of the main body in Somerset county, Pennsylvania, through a gap in the Great Back Bone and Meadow Mountains.

THE PERIODICAL CICADA PROBABLY DOES NOT OCCUR ABOVE AN ELEVATION OF 3,000 TO 3,300 FEET ANYWHERE IN THE STATE.

The information I have been able to gather from correspondents and from personal observation, leads me to believe that the periodical cicada is confined in its natural distribution in West Virginia to what is known as the upper austral and transition life zones, and that it will rarely occur in the Canadian Zone which lies above an elevation of 3,000 feet.

TIME OF FIRST GENERAL APPEARANCE.

The time of first general appearance of the swarm varied considerably. Between the northern and southern border there was, as indicated by the records, a difference of nearly two weeks and between the lowest and the highest elevations within the area covered by this brood, there appears to have been a difference of nearly four weeks.

This variation appears to be due to the difference in climate between southern and northern sections and low and high elevations, which in the former, amounts to some 3.5 degrees, and in the latter over 10 degrees in average summer temperature. The latter being equal to the difference in the climate or average temperature between Chattanooga, Tenn., and Cleveland, O.

From evidence gathered during the spring and summer of 1897, it would appear that there is about $3\frac{1}{2}$ days difference in the time of the first general appearance of the cicada for each degree of difference in the average summer (April to September inclusive) temperature between any two points in the State, whether it be due to difference in latitude or elevation.

Thus if, as was indicated by reports, the swarm commenced to appear near Point Pleasant between the 12th and 14th of May, they should have appeared on the hills near Morgantown between May 22d and 24th, and at the eastern border in Preston County at an elevation of 2,700 feet June 12th to 14th. My records show that the first general appearance of the swarm near Morgantown was on May 24th and that they appeared near Cranesville on June 12th.

Whether or not this average difference of $3\frac{1}{2}$ days for each difference of one degree of average summer temperature will prove to be the rule with all broods and in all seasons, I would not pretend to say, but I trust the readers of this bulletin will make a careful record of the time of the first general appearance of future swarms in their respective localities, and report the same to the Experiment Station, so that we may be able to arrive at some definite conclusions in the future.

INFLUENCE OF THE WEATHER ON THE APPEARANCE AND DEVELOPMENT OF THE ADULTS.

The period from the middle of May to the middle of June, during which the underground form of the cicada emerges and changes to the adult was most unfavorable for the appearance of the 1897 swarm, since it was unusually cold and rainy throughout the entire period. This may have somewhat retarded the time of their appearance, but it was noted that while they came out of the ground in greater numbers during the clear and warm evenings, very many emerged when it was cold enough to chill them so they could scarcely crawl, and few were able to extract themselves from their shells. They were thus easy prey for their numerous natural enemies, such as poultry, birds, and predatory insects, among which the common ant was noticed attacking and feeding upon the helpless victims while they were yet alive, while poultry and English sparrows destroyed immense numbers of them, and the frequent cold rains must have almost exterminated them in some localities long before the time for their natural disappearance.

SUMMARY OF VOLUNTARY INFORMATION BY CORRESPONDENTS.

LOCALITIES IN WHICH THE CICADA WAS REPORTED AS MOST ABUNDANT.

Reports from correspondents indicate that the localities in which the cicada occurred in greatest abundance were in the vicinity of Deepwater and Montgomery, Fayette County ; Troy,

Gilmer County; Holliday's Cove, Hancock County; Jackson, Elk Fork, Cottageville, Angerona and Grasslick, Jackson County; on hills near Moundsville, Marshall County; and Wheeling, Ohio County; in localities near Buffalo and McGill; on east side of river from Extra, Putnam County; near Sassafras, Mason County; Craigsville and Ophelia, Nicholas County; Josiah, Pleasants County; and on mountains west of Cranesville, Preston County; also near Big Otter and Clay, in Clay County; Kingsville, and Valley Head, Randolph County; Hartley, Ritchie County; McKin, Tyler County; Buckhannon, Upshur County; New England, Washington and Athey, Wood County; Petersburg, Grant County; Bridgeport, Harrison County; Handley, Shrewsbury, Island Branch, Cannelton and Apgah, Kanawha County; Thornburn, Marion County; Oakville and Rion, Roane County; St. George and Texas, Tucker County.

LOCALITIES WHERE THEY WERE REPORTED AS MORE NUMEROUS THAN
IN FORMER YEARS.

The localities in which the cicada was reported to be more numerous than in former years were near Grasslick, Jackson County; Sassafras, Mason County (reported "thicker than they were ever known by the oldest inhabitants;") Craigsville, Nicholas County; Josiah, Pleasants County; Buckhannon, Upshur County, (where they were "More than in 1880, but not so many as in 1863;") near Helvetia, Randolph County, (where there were a "few in 1863, more in 1880, and a great many more this year,") 1897.

LOCALITIES WHERE THEY WERE NOT SO NUMEROUS AS FORMERLY.

Correspondents from Hebron, Pleasants County; New Martinsville, Wetzel County; Flint, Doddridge County; Miger, (Rosby's Rocks), Marshall County; Point Pleasant, Mason County; and Edra, Pocahontas County; reported that the locust was not as numerous as formerly.

PLACES WHERE A FEW WERE OBSERVED.

Congo, Hancock county; Snow Hill and Lewacy, Nicholas

county; South Mill Creek, Pendleton county; Traveler's Repose, Pocahontas county.

PLACES WHERE BUT ONE EXAMPLE WAS SEEN OR HEARD.

Bald Knob, Boone county, (observed); Lewisburg, Greenbrier county, (observed); Wayne and Echo, Wayne county, (heard); and Barnum, Mineral county, (observed.)

PLACES WHERE THE DAMAGE TO FRUIT TREES WAS REPORTED AS GREAT, CONSIDERABLE OR SLIGHT.

Deepwater, Fayette county, two correspondents—one reported that the locust was “killing all of the fruit trees,” the other that the “trees were smothered to death with locusts.” At McGill, Putnam county, one correspondent reports that the locust did “great damage to young orchards, and that the limbs fell down from being split.” Eagle, Fayette county, slight; Sunset, Pocahontas county, “killed small peach trees.” Troy, Gilmer county, considerable damage; Sherrard, Marshall county, slight.

The following valuable and interesting communication was received after the manuscript for this bulletin was prepared.

The record of 102 years, as given by Mr. Haymond, is doubtless the best that has ever been furnished with reference to brood XV, and since it is from the most reliable source, it gives us great pleasure to present herewith a copy of his letter.

CLARKSBURG, W. VA., Jan. 18th, 1898.

A. D. HOPKINS, ESQ.,

MORGANTOWN, W. VA.

DEAR SIR:—

I have received your letter of the 14th inst., asking for such information as I can furnish in regard to the periodical cicada, generally known as the 17 year locust.

The cicada of this county commenced coming out of the ground on the dates following:

May 15, 1795.

May 25, 1812.

May 25, 1829.

May 14, 1846.

May 25, 1863.

May 17, 1880.

May 21, 1897.

The first two dates I procured from my father, the others are the result of my own observation. I was three years and three months of age when the cicada appeared in 1812, but I do not recollect that I saw them.

The date of their first appearance is influenced somewhat by the weather and the temperature. In 1897, it was cold about the 22d of May, and many of them perished. They continued to come up for about two weeks this year, and by the 21st of June, appeared to have disappeared in this neighborhood.

I have endeavored to ascertain the extent of this locust district, but have made poor progress. I am informed that they did not appear at Charleston, but were numerous in Nicholas County. They appeared in Meigs County, Ohio. I suppose in this State, that the district does not extend to the Great Kanawha River, and is bounded by an irregular line north of that river. It is said that they appeared in Grant County, this State. I had previously supposed that the district did not extend east of the Allegheny Mountains. It extends quite extensively into the State of Ohio.

As to Pennsylvania, have no information in regard to the cicada.

All the harm this insect is properly chargeable with is in puncturing the small branches of trees with their ovipositors, to lay their eggs for the next brood in 1914. They do not eat anything and the males do the singing.

In old times there was a superstitious notion that sometimes the cicada had the letters P and W on their wings, indicating peace and war, but I find the same character appears on the wing every year, generally resembling the letter N.

I regret that I cannot furnish you with more valuable information, but such as it is I furnish it cheerfully.

Very respectfully,

LUTHER HAYMOND.

There is another species of the cicada, considerably larger than the 17 year variety, which appears in August every year, but there is not many of them. They come up out of the the ground as the others do, leaving their holes [shells] behind them. How long they live in the ground is a problem hard to solve. My guess is 20 years.

L. H.

SOME RECORDS OF OBSERVATIONS BY THE AUTHOR.

ONE EXAMPLE EVIDENTLY BELONGING TO THIS BROOD COLLECTED
IN MAY, 1895.

It is not uncommon for a few examples of a brood to appear one year in advance, or one year after the regular time for the swarm to come forth, but for any member of the brood to come out two years ahead of time is quite an unusual occurrence. I have an example, however, that was taken by my son, Edwin, near our home in Monongalia county, on May 31st, 1895, which could not well belong to any other brood than the one under discussion, unless it should have been one of the last survivors of a disappearing brood, or the representative of a new brood just started. Brood XIII appeared, according to J. B. Smith,¹ throughout a larger part of Iowa and probably in Illinois and Missouri during 1895, but it is not likely that it could have belonged to this brood. Brood II, which belongs to the thirteenth year race also appeared the same year in north western Georgia, but it is not possible that it could belong to the thirteenth year race, which has never been recorded so far north. I know of but one other record of the cicada appearing two years before the regular time.² So it would appear that these early risers deserve to be labeled "record breakers" of the seventeenth year race, or possibly examples of a connecting link between the seventeenth year race of the north and the thirteenth year race of the south.

NONE WERE SEEN OR HEARD IN THE SPRING OF 1896.

As previously stated, it is common for a few examples to emerge a year in advance of the regular time of their appearance, therefore, in May and June, 1896, I was on the lookout for the appearance of the precursors of the 1897 swarms of brood XV, but I failed to see or hear a single adult. The young or underground form came up quite near the surface in enormous numbers during the month of April, as if preparing to

¹Smith's Economic Entomology, 1896. p. 144.

²Insect Life, Vol. V, p. 50.—Reported by B. H. Brodnax.

emerge from the ground, but none came out. In taking up sod at the time, I noted that quite a large proportion of them were dead and had turned black as if they had died from a disease, which, if so, must have greatly reduced their numbers.

THE SONG OF THE CICADA HEARD IN SEPTEMBER 1896.

While looking after some timber experiments, on September 26th, 1896, in the mountains some seven miles from Morgantown, in company with Mr. Samuel Sanders, near the home of the latter on Tibb's Run, we distinctly heard the characteristic "f-a-r-r-o" notes of a number of examples of the cicada, and on the following day, I heard one near my home. None were seen, however, so it was only by the characteristic sound that they were identified, yet I feel quite sure that they were examples of the true periodical cicada. The only other records I find of the appearance of the insect in the fall, is that of Prof. Lester F. Ward, who stated before the Biological Society of Washington that he heard the song of the cicada in October, and of Dr. Fitch who mentioned in his first report, p. 42, that he heard the song of a cicada on September 22, [1854,] which he thought might have been a straggler from the swarm which appeared in the spring of that year.

NIGHT CONCERTS.

On two or three nights in June, between the hours of nine and ten o'clock, I heard the cicada singing as vigorously as in the day time. The concert, which lasted but a short time, was apparently started by one or two insects when the others in all directions commenced to sing. I was fortunate enough to hear the starting of one of these night concerts on a clear moonlight night in June. One male in an apple tree near the house suddenly called out as if disturbed or frightened. His neighbors in the same tree were thus apparently awakened. One started the familiar song note, which was at once taken up by numbers of the other males, and like the waves from a pebble dropped into still water, the music rapidly spread until it reached the edge of a thick woods, where it was taken up by many thousands of singers and the concert was

in as full blast as it had been the previous day. This continued a few minutes until all had apparently taken part and the sound had reached its highest pitch, when it began to gradually subside, and in a short time silence again prevailed.

A VISIT TO THE BORDER OF THE BROOD.

On June 23d, Mr. Rumsey and the writer drove through to Cranesville, Preston county, which is near the Maryland line, at an altitude of about 2,600 feet, and some thirty miles distant from Morgantown. During the day's drive, which for the greater part was over mountain roads and through a timbered country, the never-ceasing song of the cicada, which in places was almost deafening, became very monotonous. As we approached the eastern border of the county, they became more numerous, and as we ascended the mountain west of Cranesville, we found, at an elevation of about 2,600 to 2,800 feet, the cicada in far great numbers than at any point along our route. The leaves and twigs of the trees along the road were literally covered with the insects, and the twigs were bending from their weight. At this point, which proved to be the eastern border of the swarm, the noise produced by the multiplied thousands of cicada songsters was deafening. As we proceeded a few hundred yards farther up, fewer examples were seen or heard, and by the time the summit was reached, none at all.

From here down the eastern slope and to Cranesville, not a note was heard, and the silence from contrast with the continual din of the day was oppressing. As we returned by another route northward by the road leading to the eastern corner of the State, we met with the border of the swarm a short distance up the southeastern slope of the mountain, and from there on to the Pennsylvania line, the cicada was abundant, although not so much so as at the border line on the western slope. It would therefore seem quite important that the boundary of this and other broods should be accurately determined and mapped, since if it is the rule for them to occur in great numbers at such places, it will follow that greater damage will be done there. Also where the borders of two or more broods meet and overlap, which they frequently do, as will be shown

further on they will appear at shorter intervals and the losses from their injuries to fruit trees will be increased.

FIRST APPEARANCE NEAR MORGANTOWN.

On the hills near Morgantown, at an elevation 1,100 to 1,300 feet, the first adults were observed on May 20th, but it was not until May 24th that the first general appearance of the insect was noted. On this date, in the evening, they emerged from the ground in great numbers, and the next morning, the trunks of the apple trees were covered with their empty shells.¹ This first general appearance was followed by quite cool, rainy weather until the 30th, when there was as another general exodus of the pupae from the ground. Under some of the old apple trees, the ground was literally covered with them, and all within a radius of 30 to 40 feet were moving towards the trees as rapidly as their clumsy legs would carry them.

This habit of proceeding from such a distance directly towards the nearest tree, as soon as they emerge from the ground, is a remarkable exhibition of so-called instinct, especially when we take into consideration that nearly seventeen years has elapsed since the young things left the eggs in the twigs of the tree to enter the ground.

Between May 27th and 30th, the first song of the cicada was heard, and by the 9th of June, when they commenced to copulate, the noise made by them was almost deafening.

The females commence ovipositing about June 13th, and on June 17th, the leaves on the wounded twigs commence to wilt.

The small variety came out later than the large or normal form, and among the last pupae that emerged the small ones predominated. Their peculiar note was also heard for some time after that of their larger brothers had ceased.

By the last week in June all had disappeared except a few stragglers, and after the 4th of July, none were heard.

The eggs in twigs I had collected, commenced to hatch on

¹ Out of 350 examples collected, 214 were males and 136 were females. The 350 nearly filled a quart measure, and 30 average examples weighed one ounce.

August 20th, and in about a week all the young had apparently emerged.

The eggs in twigs that died soon after they had been attacked did not hatch, especially in those twigs which remained on the tree.

It therefore seems necessary, as other writers have noted, for the eggs to remain in living, or at least moist wood, in order to hatch.

BRIEF ACCOUNT OF THE OTHER BROODS AND THEIR PROBABLE DISTRIBUTION.

BROOD XVII, 1881-1898.

The earliest record of this brood was from Wheeling, Va., (now West Virginia), in 1830,¹ and was subsequently reported from the same place in 1847 and 1864; also from northeastern Ohio, western Pennsylvania, New York, New Jersey, Wisconsin, and North Carolina. There appears to be no record of its reappearance at Wheeling in 1881, and Prof. Webster² states that it has not been reported from Ohio since 1864. Recent writers agree that this is a small brood, apparently dying out, especially in the southern range of its distribution.

THE 1898 SWARM.

The fact that brood XVII has been referred to as dying out, and that no records are found of the reappearance of an 1881 swarm, the 1898 swarm will probably not occur in sufficient numbers to attract attention. It should, however, be looked for in Hancock, Brooke, Ohio, and Marshall Counties next May and June. It must be remembered, however, that this area was occupied by brood XV, and that possibly a few stragglers of this brood may appear in the spring of 1898. Therefore, unless the insect occurs in considerable numbers, it could hardly be claimed that they belonged to brood XVII.

BROOD XX, 1883-1900.

This brood has been known to occur in northern and western New York, eastern Ohio, and western Pennsylvania since 1832

¹1st Rept. Insects of Mo. C. V. Riley—Reported by Dr. Smith, p 36.

²Bull. 87, Ohio Experiment Station, p 40.

and 1849, but had not been recorded as occurring in West Virginia. This is also referred to as a small brood which does not attract much attention, except in a few comparatively small areas.

THE 1900 SWARM.

Mr. L. S. Bambrick, of New Cumberland, Hancock County, states in reply to my inquiry, that the locust occurred in that locality "in 1883." Since the brood occurred in eastern Ohio and western Pennsylvania, it is very probable that it occurs in the bordering counties in West Virginia. Therefore, it should be looked for in May and June, 1900, in Hancock, Brooke, Ohio and possibly Marshall and Wetzel counties.

BROOD XXI, 1884-1901.

This, like brood XV and XVII, was first recorded from the West Virginia area, it having been reported from Monroe county in 1833 and 1850. It was subsequently reported as occurring in North Carolina, and Eastern Virginia. The swarms of this brood are reported as being much larger than those of broods XVII and XX, therefore it is quite important that the area occupied by it should be accurately determined. Up to 1897, it had only been recorded from Monroe and adjoining counties, but the indications are that it covers quite a large area in the State.

THE 1901 SWARM.

Replies to my card of inquiry from correspondents in Mercer, Monroe, Pocahontas, Greenbrier, Raleigh, Summers, Fayette counties, and from statements by parties living in Randolph and Preston counties, would indicate that it occurs in all of these counties, and if so, comes next to brood XV in the area occupied.

Mr. J. J. Echols, of Lewisburg, states: "I think they occurred here in 1884; am told locust year will be in 1899." [1901?]

† 1st Rpt. Insects Mo. p. 40, reported by Dr. Smith.

Mr. W. M. Reynolds, of Athens, Mercer County, states: that the locust occurred in 1884 in Mercer "and all the adjacent counties in full force, doing considerable damage to all young orchards."

Mr. C. L. Harvey, writing from Oatvale, Monroe County, says from circumstances, he thinks 1900 will be locust year.

The postmaster at Buckeye, Pocahontas County, states that "locust year in this county will be 1901."

Similar reports were received from Roxie, Sunflower, Prosperity, and Table Rock, Raleigh County; Clayton, Summers County; and Deepwater, Fayette County.

A Mr. Denton told me that he was positive that locusts occurred near Elkins, Randolph County, in 1884, and that they were very numerous. Mr. John Gooseman, who lives near Reedsville, Preston County, told me in 1896, that he saw locusts in Monongalia County in 1863, and in Preston County in 1880, and that there was also a 13-year brood in Preston County in 1884. Since we have no 13-year broods in the State, this was evidently brood XX. This would indicate that possibly a spur or detached section of the main body may extend down the valley of Valley River and across into Preston county, which if so, would be very interesting, since it would indicate that it had come through, or over, the high mountains at the head of Valley River, by the same route as that which a detachment of brood XV passed from this valley into Pocahontas county.

BROOD XXII, 1885-1902.

This brood, which was first recorded in 1715, is said to be by far the largest brood of the seventeenth year race of the periodical cicada.¹ It is known to occur in eighteen States, and is divided into two sections, one occupying a belt extending from New York through the eastern portion of the Appalachian range, into northern Georgia and eastern Tennessee; the other covering nearly all of Indiana and about one-half of Ohio, and small areas in Kentucky, Illinois, Michigan and Wisconsin.

¹ Report U. S. Dept. Agr. 1885.

This brood is distinguished especially in Pennsylvania, Maryland, and West Virginia, by the greater number of individuals in its periodic swarms, and is therefore liable to be the most destructive.

THE 1902 SWARM.

The area covered by this brood was quite accurately determined in 1885 by Dr. C. V. Riley, then chief of the Division of Entomology of the U. S. Department of Agriculture, and we find in his report published in the report of the U. S. Department of Agriculture for 1885, that the 1885 swarm occurred in "Berkeley, Grant, Hardy, Hampshire, and adjoining counties in West Virginia." To this we have little to add from the information obtained from last spring, except perhaps to indicate more definitely the boundaries of the area occupied.

It will evidently cover all, or the greater part of Jefferson, Berkeley, Morgan, Hampshire, and Mineral; the northern part of Hardy; and the northeastern part of Grant counties. It should also be looked for near the eastern borders of Preston, Pendleton, Pocahontas, Greenbrier, and Monroe Counties, and other counties of the State, since this being such a large brood, it is possible that such detached sections may occur almost anywhere in the State. Therefore, in order that the exact area may be determined the presence of the locust in any part of the State during May and June of 1902, should be promptly reported to the W. Va. Agricultural Experiment Station.

BROOD V, 1888-1905.

This brood had not, to my knowledge, been previously reported as occurring anywhere east of Indiana, but it would appear from information obtained from the most reliable source, that a brood corresponding this in time of appearance, occurs in Putnam County. Mr. M. V. Brown, who lives near Buffalo, Putnam County, wrote: "We had a locust scourge here in 1854, 1871, and 1888." I have since talked with Mr. Brown, and other persons living in the same county, and they are all

quite positive that the locust was very abundant in that locality in 1888.¹

Mr. J. M. Haeler, writing from near Snowden, in the adjoining county, Lincoln, states that he thinks the locust occurred there in 1888, and that they are due again in 1905.

THE 1905 SWARM.

From the above information it would appear that a swarm may be expected in Putnam County and possibly in Lincoln county in 1905, and since there are no previous published records with reference to the occurrence of this brood in the State, it is very important that our readers in that or any other section of the State should report to the Station the appearance of the cicada in May and June, 1905.

BROOD VIII, 1889-1906.

This brood is of especial interest since it is evidently the one referred to over 250 years ago, in Morton's Memorial as appearing in Plymouth, Mass., in 1633 or 1634. This earliest published reference to the periodical cicada was quoted by Harris² and Riley³ as follows:

"There was a numerous company of flies, which were like for bigness unto wasps or bumblebees; 'which appeared in Plymouth in the spring of 1633.'" "They came out of little holes in the ground * * * and made such a constant yelling noise as made the woods rings with them, and ready to deafen the hearers."

It was reported from Gallipolis in 1821 and from Kanawha, Va. (evidently Kanawha Valley) in 1855.⁴ It is known to oc-

¹ Since the above was written the following letter was received from Mr. M. V. Brown:

BUFFALO, W. VA., Jan. 19th, 1898.

DR. A. D. HOPKINS, Morgantown, W. Va.,

DEAR SIR;—Yours of Jan. 14 to hand and contents carefully noted. I have no record, but remember *distinctly* that we had a bad locust year in this vicinity, (opposite Buffalo) in 1888. I was building a barn that year, and remember *positively* that locusts were numerous. * *

I know I am not mistaken. We had locusts here in 1854, in 1871, in 1888, and I confidently expect them again in 1905. * * We have had locust years between the dates above mentioned; but the dates mentioned were the bad years, and I am satisfied that this is the 17 year brood. * *

Yours truly, M. V. BROWN.

²Harris's Insects Injurious to Vegetation. Flint Ed. p 207

³Bulletin 8, Div. of Ent. U. S. Dept. of Agr.

⁴Fitch's 1st Report of Insects of New York. p 39.

our in West Virginia, Ohio, Kentucky, Virginia and several other States. It was recorded by Mr. A. E. Schwarz¹ as occurring near Harper's Ferry, Jefferson County, in 1889. In bulletin 87 of the Ohio Experiment Station, issued in Nov. 1897, I find the following interesting reference to this brood in West Virginia in a copy of a letter from Mr. S. C. Larkin, of Rutland, Ohio, from which we quote the following:

* * "There is another locust district, lying south of ours" [1897 swarm] "whose period comes eight years before ours, the line between the two districts crosses the Ohio River from West Virginia near the mouth of Old Town creek in Ohio, then to Racine, cutting off all of the township of Letart. From Racine it passes to West Virginia and back again to Ohio at the mouth of Silver Run, just at the upper edge of Gallia county. * * * At Letart, Ohio, where they were expected in profuse numbers in 1889, there were very few."

Prof. Webster, the author of the bulletin, states (p. 42) that:

"I found Mr. Larkin's statement to be substantially correct, as applied to brood XV. The line of separation seems to cross the river near Chester, in Gallia county, Ohio."

THE 1906 SWARM.

The only additional information to that previously recorded that I can give here is that obtained from Maj. E. A. Bennett, of Huntington, Cabell county, whose letter I quote in full:

"Replying to your letter about the visitations of the seventeen year locusts, they infested this (Cabell) and adjoining counties in 1889, and were very abundant in the neighborhood of Huntington. I planted a large number of fruit trees in the spring of 1889, in land cleared the previous winter, which fell a prey to the ravages of these insects. I adopted the method of cutting out all limbs that were seriously wounded by them, except that where all the branches were seriously hurt I cut off all but one or two branches, which were left to support some leaf growth until new shoots could grow, after which those so retained, were, in turn, lopped off. It was found that small limbs and twigs of young trees severely wounded by locusts did not heal up and grow, but were ultimately broken off by the winds at the place scared by them. This treatment proved to be the best of several methods experimented with."

Mr. J. C. Livejay, writing from Pliny, Putnam County, states:

"There are no locusts in this vicinity below the Kanawha River. Was here about nine years ago."

¹ Proc. Ent. Soc. of Washington, 1889, p. 230.

~~Dr.~~ Peter S. Couch, writing from Southside, Putnam County, states:

"If I remember rightly, it will be about ten years until we have our swarm of them."

It would appear from the above records and information that the 1906 swarm may be looked for in the western corner of Jackson, throughout Mason, Putnam, Cabell, Wayne, and Lincoln, and possibly Boone, Logan and Mingo, also the southern part of Kanawha. It may also join and overlap brood XXI in Fayette, Raleigh, Wyoming and McDowell and possibly in the eastern edges of the counties bordering on Virginia, from Monroe to Jefferson, since it is known to extend through Virginia, and to occur in Jefferson county.

The swarms of this brood are referred to as being very large and destructive, and therefore it is important that information should be sent to the Experiment Station from every postoffice at or near which it appears in 1906.

BROOD XI, 1893-1910.

This brood which was first recorded from the valley of Virginia in 1808, extends from North Carolina through Virginia into Maryland. It has also been recorded from Indiana, Illinois, Kansas, Kentucky and Tennessee, but no published records are found of its occurrence in West Virginia. That it does occur in this State, however, the following quotations from correspondents will show:

THE 1910 SWARM.

The information received from correspondents last spring indicate that a swarm of this brood appeared over the greater part of Pendleton, the southern part of Grant and Hardy, and in a small section in Randolph county; also possibly in Jefferson.

Mr. J. G. Hannon, writing from Petersburg, Grant county, gives the following important information:

"The seventeen-year locusts are here by millions; were here seventeen years ago; also thirty-four years ago. They extend about four miles south, and there they come to the line where the locusts were four years ago. This line extends as far east and west as I am acquainted with the county. I remember when I first knew anything about the locust was in 1842; the

next time in 1859; then 1876; and 1893, and always four years later."

In another letter in reply to my request for further information with reference to the dividing line between the 1893 and 1897 swarms, Mr. Hannon says:

"The line that divides the area of the cicada, as stated in my other letter, commences on the western part of Grant County and near the Pendleton line, about four miles south of Hopeville P. O., and then about one mile north of Pensy P. O., and a short distance south of Masonville P. O., with a straight line through Hardy County, and entirely to the Virginia State line; from there I am not acquainted with the line, but I have traveled this county and Hardy, and know my statement to be correct."

Mr. W. L. Kellerman, of Kellerman, Grant County, states on card dated June 22nd, 1897:

"The locust did not occur here this year; it occurred here in 1894" [1893?].

Mr. S. E. Hinkle, of Seemly, Grant County, says: "The seventeen year locust is not in the vicinity of this office, but is about three miles northeast from here. They were here four years ago (1893)."

Correspondents from the following postoffices in Pendleton county state that the locusts occurred in 1893:

F. D. Segbert, Sugar Grove, Sweedlen Hill, Shreves, Brushy Run, and Oak Flat.

J. C. Harper, postmaster at Day's Mills, Randolph county, states on card dated June 19th, 1897: "The seventeen year locust was in our vicinity in 1893; none here this year. I have seen four locust years." If he refers to this brood the ~~zone~~ *year* would be 1842, 1859, 1876, 1893.

This locality is of especial interest, since it is probably another example of a small detached section which has established itself on the opposite side of the main ridge of the Allegheny Mountains. Day's Mills is at an elevation of 2,500 feet in a narrow valley surrounded by high mountains 3,000 to 4,000 feet altitude and it seems quite remarkable that the insect should find its way in there and establish a colony.

SECTIONS IN WHICH TWO OR MORE BROODS OVERLAP.

HANCOCK, BROOKE AND OHIO COUNTIES.

Commencing in the northern panhandle, we find that broods XV, XVII and XX will probably overlap in Hancock, Brooke and Ohio counties, and possibly in Marshall and Wetzel, so that three swarms may occur here in four years. 1897, 1898, 1900 and then be exempt for thirteen years. As previously stated, brood XVII may have died out in this section, and brood XX may only appear in limited numbers.

PRESTON COUNTY.

Brood XXII, 1902, may possibly overlap Brood XV, 1897, in the eastern border of Preston County, and brood XXI may overlap brood XV in the western part of the county near Reedsville. If so, three swarms appear in this county in five years, 1897, 1901, 1902, then exempt twelve years to 1914.

JEFFERSON AND BERKELEY.

Jefferson County appears to have three broods: broods XXII, 1902; brood VIII, 1906; and brood XI, 1910. Thus, in the eastern part of the county three swarms may be expected in 8 years: 1902, 1906, 1910, then exempt 13 years to 1923.

MINERAL COUNTY.

Broods XXII, 1902, and XV, 1897, probably overlap where the narrow strip of the latter crosses the mountain. Thus at this point there are two swarms in five years, 1897, 1902, then exempt twelve years until 1914.

GRANT AND HARDY COUNTIES.

In Hardy County brood XV, 1897, and brood XXII, 1902, overlap from near the Hampshire County line to near Baker, Moorefield, and Fabins postoffices in Hardy. In Grant County, the same broods overlap, to near Medley, so that in the northern third of Hardy and the northeastern corner of Grant, two swarms, 1897, and 1902, occur in four years; then exempt thirteen years to 1914.

In the southern portion of both Hardy and Grant, the line separating brood XV and XI appears to be quite distinctly

marked; so that probably very little overlapping occurs. Where they do overlap, two swarms occur in four years, 1893 and 1897, then exempt thirteen years until 1910.

Mr. B. J. Ward, of Moorefield, Hardy county, states: "If I have kept my records right, we have them every seventeen and and thirteen years. We had them in 1880, 1884, [1885?] and 1871." If this last date is correct, a swarm should occur there in 1905, and if so, would overlap one or more of the other broods.

Thus, three well established broods occur in Grant and Hardy counties, with a possibility of four or five, since spurs from brood VIII, 1906, XXI, 1901, might easily extend into these counties. As it is, a swarm appears in these counties four times within seventeen years, 1897, 1902, 1910, 1914, or in periods of five, eight and four years.

PENDLETON COUNTY.

Situated as this county is, close to territory in this State and Virginia, which is known to be occupied by four or five broods, it would be strange, indeed, if some of them do not enter this county and overlap brood XI, which appears to occupy the entire county except, perhaps, the summit of the higher mountains.

RANDOLPH COUNTY.

Brood XV, 1897, is the predominating brood in this county which appears to occupy all of the area below an elevation of 3,000 feet, except, perhaps, that occupied by a section of brood XI near Day's Mills. The only other brood that is likely to occur in this county is brood XXI, which was reported as occurring near Elkins. Therefore, there may be a strip or detached sections along the Valley River valley and adjacent foot hills of the mountains on either side, where brood XV, 1897, and brood XXI, 1901, overlap. In such places, two swarms would occur in four years, then would be exempt thirteen years to 1914. Brood XI, 1910, may join and overlap brood XV 1897, between Day's Mills and the Tucker County line. If so, there will be two broods there in thirteen years,

then exempt four years. Thus the county appears to have three broods, swarms of which may appear in 1901, 1910, and 1914, or four swarms in seventeen years, divided into periods of four, nine, and four years.

POCAHONTAS COUNTY.

This county has two well recorded broods, XV, 1897, and XXI, 1901, with a probability of brood XI, 1910, in the northeastern corner, and brood XXII along the eastern border. Broods XV and XXI evidently overlap in a strip running northeast across the middle of the county, where swarms would occur, at intervals of four and thirteen years, or three swarms in seventeen years, 1897, 1901, and 1914.

FAYETTE COUNTY.

This county has two broods, XV, 1897, and ~~XI~~ XI, 1901, which evidently join and overlap in a strip running through the northwestern corner of the county, where swarms occur in periods of four and thirteen years, or three swarms in seventeen years, 1897, 1901 and 1914.

KANAWHA COUNTY.

This county evidently has two broods, XV, 1897, and VIII, 1906, and possibly brood ~~XI~~ XI, 1901, which if so, join and probably overlap in a strip running east and west through the southern part, where swarms would appear at intervals of four, five and eight years, or four swarms in 17 years, 1897, 1901, 1906 and 1914.

PUTNAM COUNTY.

According to present information, this county has three broods, XV, 1897, V, 1905, and VIII, 1906, which probably join and overlap in a rather broad strip running northwest through the county, in which four swarms may occur in seventeen years, 1897, 1905, 1906 and 1914, in periods of eight, one and eight years.

MASON COUNTY.

This county has two broods, XV, 1897, and VIII, 1906, which evidently join and overlap in a broad belt through the north-

eastern half of the county, in which three swarms would occur in seventeen years, 1897, 1906, and 1914, in periods of nine and eight years.

JACKSON COUNTY.

This county possibly has two broods, XV, 1897, and VIII, 1906, which may overlap near the southwestern border, where if so, there are three swarms in seventeen years, 1897, 1906 and 1914, in periods of nine and eight years.

IN THE STATE.

From the foregoing records and information, it appears that there are eight broods of the periodical cicada in the State, and that nine swarms occur within its borders in each *period of seventeen years*; 1897, 1898, 1900, 1901, 1902, 1905, 1906, 1910, 1914, in periods of 1, 2, 1, 1, 3, 1, 4 and 4 years=17.

RECORD OF SOME RECENT OBSERVATIONS.

On Jan. 20th, 1898, I had some dead and dying apple trees cut down and the dead and diseased branches pruned from others in an old orchard, on a recently purchased farm, and in examining the trunks and branches for evidences of the cause of their deterioration, some interesting and probably new observations were made with reference to the work of the cicada, woolly aphid and tree crickets.

SECONDARY INJURY BY THE WOOLLY APHID OR WOOLLY LOUSE OF THE APPLE.

The first thing to attract my attention was the presence of the woolly aphid in the cicada wounds of the living twigs. Knowing that it is the habit of this insect to infect wounds on the trunk and branches of apple trees, and that they not only prevent the wound from healing, but cause an abnormal growth which ultimately results in a serious defect or loss of the injured branch, I realized that the secondary attack of the aphid on twigs injured by the cicada might easily result in serious damage to old as well as young trees. Search was therefore made for old cicada wounds, and abundant evidence was soon found that much of the unhealthy condition of the trees and

branches was due, primarily, to injuries by the periodical cicada, and one or two species of tree crickets, and secondarily, to the woolly aphis, diseases and other insects.

CICADA WOUNDS SEVENTEEN YEARS OLD.

It has been supposed that the only injury of any consequence caused by the cicada, was that resulting from their attack on young trees, but it would appear from the evidence found in the condition of the seventeen-year old wounds, on large apple and pear trees, that the losses occasioned from this class of injuries have been underestimated.

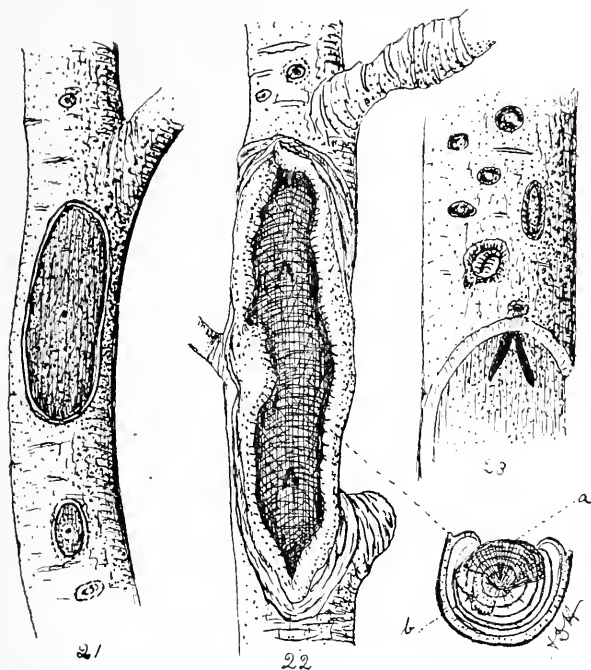
Cicada wounds in the trunks or branches of trees which are in a vigorous, growing condition, will rapidly heal, and in a few years, even the scars may be obliterated, but with recently transplanted trees and fruiting or terminal branches on matured or old ones the condition is quite different. Here the growth is so slow that the wound is not healed the first or second year, but may remain open for many years, or, in the case of terminal branches on old trees, may never heal, even if the branch lives, so that the wounds are exposed year after year, to the attack of the woolly aphis, and deformed, unproductive branches is the result.

Abundant examples of this condition were found in the old orchard referred to, and doubtless any of our readers can find the same thing, who have old orchards in sections where large swarms of the cicada have appeared within the last twenty years.

OLD CICADA WOUNDS IN SUGAR MAPLE.

The sugar, or hard, maple appears to be the favorite tree for the cicada to oviposit in, therefore, after I found the old wounds in apple, I examined a near-by sugar maple, and found numerous examples of cicada scars on the branches which had made a slow growth. The external appearance of these scars and the curly condition of the wood formed over the wound, are plainly shown in the photograph. Plate IV. This curly condition of the wood, due to cicada wounds, would indicate that numerous wounds in the main

stem of a young seedling maple, might easily result in a curly condition of the wood in the trunk of a matured tree.



WORK OF A TREE CRICKET.

Fig. 21, punctures with areas of blighted bark.

Fig. 22, old wound prevented from healing by the woolly aphis; also section across wound, showing dead wood at *a* and dying wood at *b*.

Fig. 23, old punctures which have healed without harm, and bark removed to show form of egg cavities, the latter enlarged.

A SERIOUS INJURY TO OLD APPLE TREES, CAUSED BY TREE CRICKETS.

I have been puzzled, for several years, over a peculiar injury to apple trees which appears to be common in all old orchards, and is quite a serious trouble in some localities. The character of the injury is clearly shown in Figs. 21, 22, and 23, and in the reproduced photographs, Plate III.

A quite small and nearly round puncture is made through the outer bark, and from one to two long cavities are formed in the inner bark and sometimes grooving the outer surface of the

wood. The wound thus made sometimes heals without doing harm, but it often causes a blighted condition of the bark as shown in Fig. 21 and if the entire branch does not die, and it often does not, the woolly aphis attacks the edges of the wound and prevents it from healing. Thus an ugly scar or deformed place is the result, as in Fig. 22. Many branches so injured, ultimately break off or die, so that the injury to a tree may be such as to cause it to rapidly deteriorate and soon become worthless as a fruit producer. This much had been determined from specimens sent to the Station and from information obtained from correspondence, but since no published reference to a trouble of this character could be found, and no insect had been observed at work, or eggs found in the cavities, I was not able to determine the kind of insect to blame for it. The single egg cavities resembled those made by certain tree-hoppers while the double cavities closely resemble the work of a cicada.

When I found that this peculiar injury was quite common in the old orchard under discussion, I made earnest search for eggs of the insect and was fortunate enough to find them. Upon careful examination and comparison with the eggs of three species of tree crickets, it was plain to me that they were eggs of this class of insects, and that since the eggs were found in the characteristic egg cavities, it was plain that one or two species of tree crickets are primarily to blame for the trouble referred to.

It appears that the insect does not oviposit in rapidly growing branches on young trees, but selects those which are making quite slow growth. Thus, when the wound is attended with blight, and is subsequently attacked by the woolly aphis, the wound seldom heals, and the exposed wood commence to decay, and the branch dies, breaks off, or becomes unproductive.

I shall endeavor to find out more about the habits and distribution of the tree cricket that causes this trouble, and will be greatly obliged for information from our readers in different sections of the State, with reference to the presence or absence

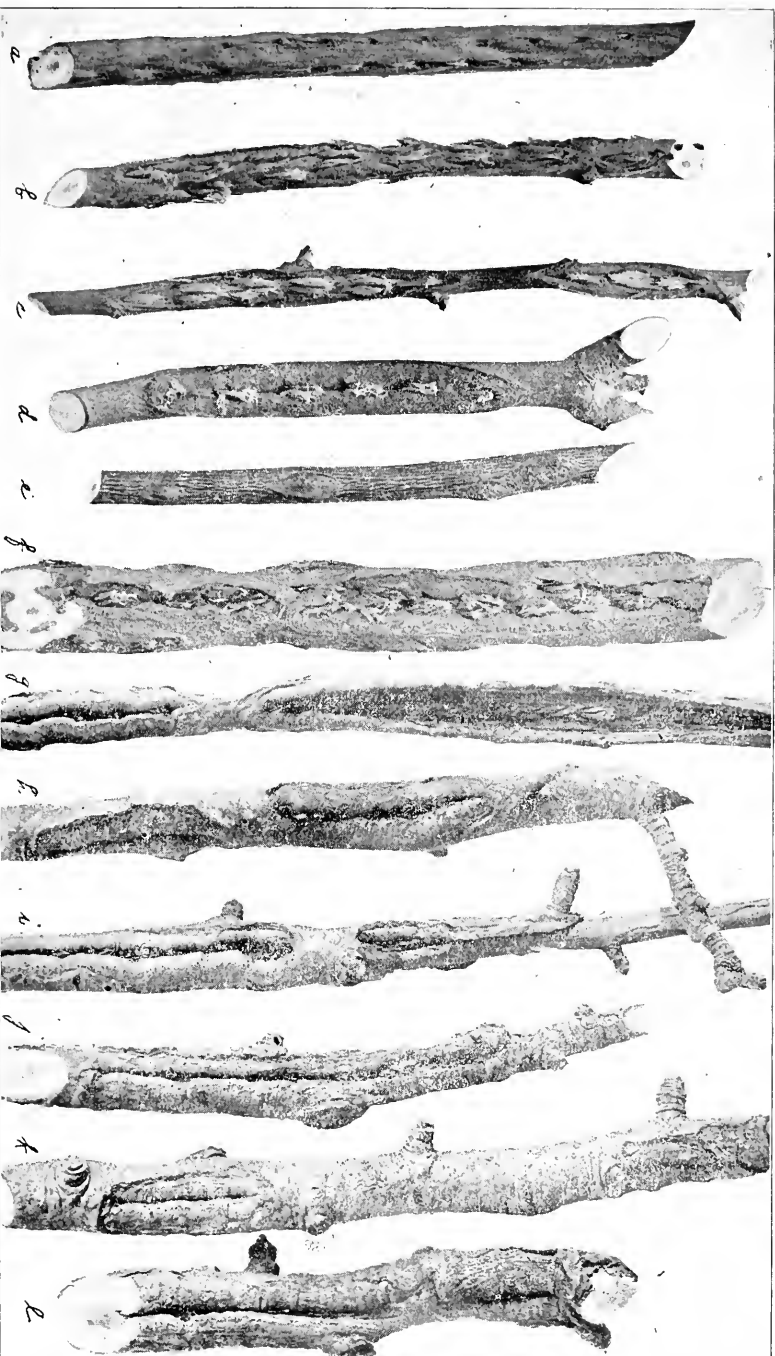


PLATE II.—WORK OF THE PERIODICAL CICADA.

a, Fresh wounds in maple; *b*, *d*, *e* and *f* condition four months later in maple; *c*, Wounds healed in one season; *b*, Three months old scars in wild cherry, showing that the punctures may extend both toward the top and base of the twig; *g-l*, Cicada scars 17 years old on terminal branches from old apple trees; *g*, *h*, *i*, apple; *j*, *k*, *l*, pear.

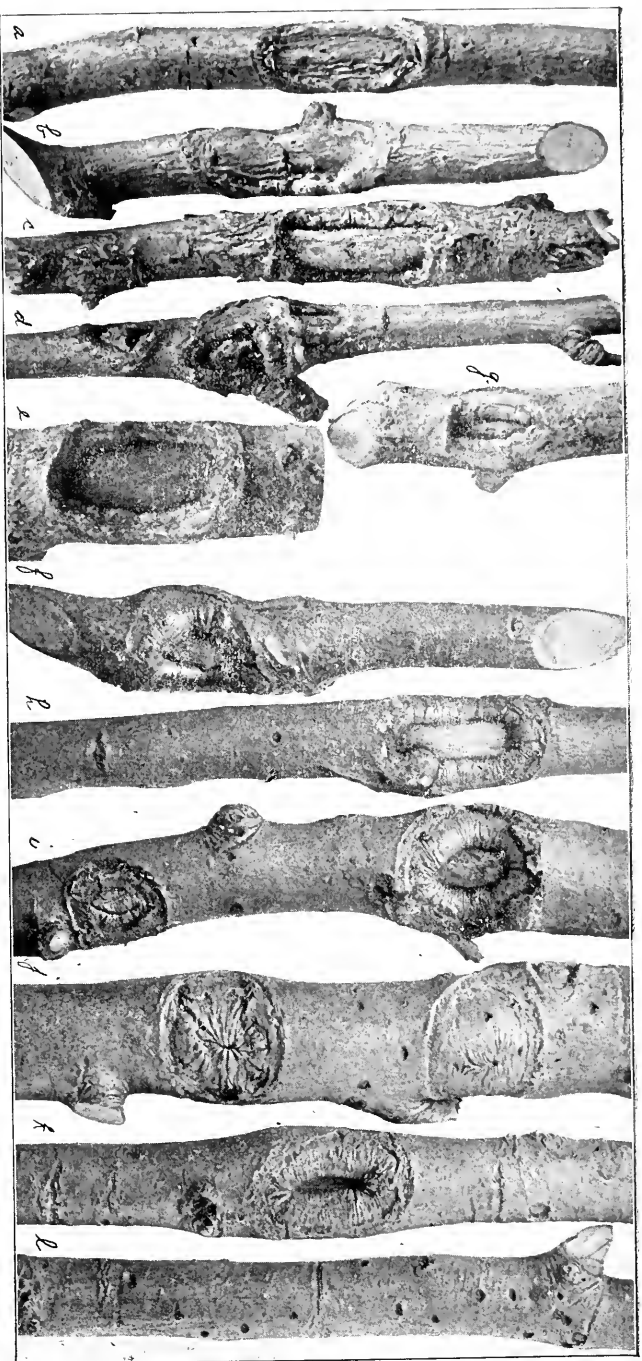


PLATE III.—WORK OF TREE-CRICKETS AND WOOLLY APHIDS IN APPLES.

a, Scars one year old. Note dead bark with punctures in the center. *b*, Scars two years old, dead bark coming off. *c*, Old scars prevented from healing by the Woolly Aphids. Note grooves made by the ovipositor of the cricket. *d*, Deformed twigs resulting from the attack of crickets and aphids. *e* to *h*, Old unhealed scars. *i*, Old scars completely closed. *j*, Old punctures which healed without harm to the bark, leaving shot-hole scars.

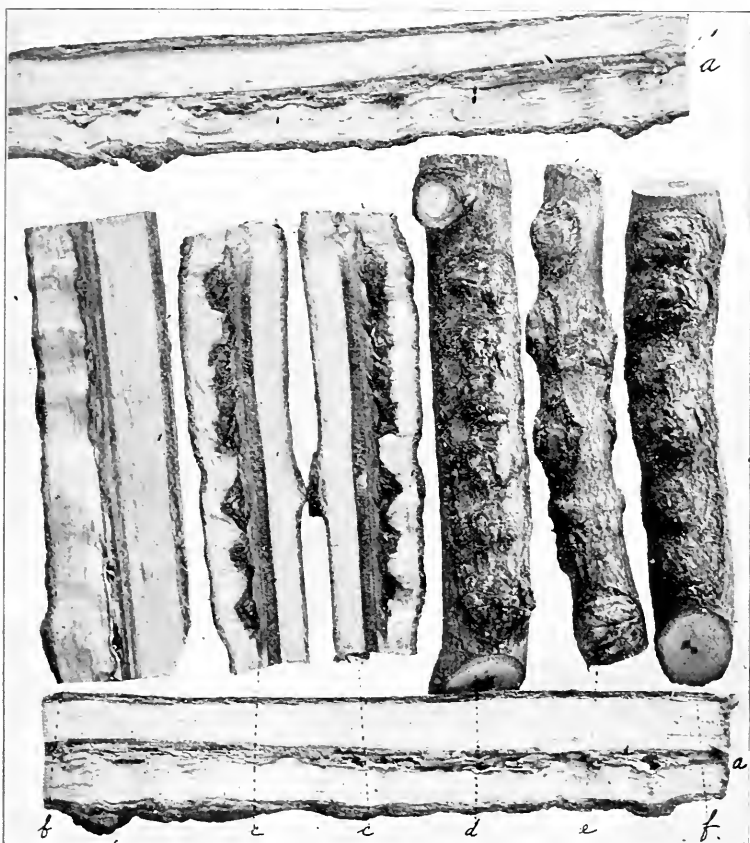


PLATE IV—Work of the Periodical Cicada, seventeen years old, in slow growing sugar or hard maple. Showing external appearance of scars at *d*, *e*, *f*. Method of healing and resulting curly condition in specimen *f*, Plate II, in main stem of young tree, which in connection with conditions as shown in these specimens, indicates one probable cause of "curly maple."

of the trouble, and whether or not much damage is done to apple trees in their vicinity. The illustrations, Plate III, will enable any one to readily recognize the character of the work of the insect.

TREATMENT OF OLD TREES INJURED BY THE CICADA AND TREE CRICKETS

In the treatment of matured or old trees which have been badly stung by the cicada, the prime objects to be kept in mind are a rapid healing of the wounds and the prevention of secondary attacks by the woolly aphis. The first object may be attained by a severe pruning of the tree during the following winter after the attack was made. All of the severely injured and unproductive branches should be cut out. This will cause renewed vigor to be thrown into the remaining branches, and thus the wounds which are not cut out, will soon heal over.

Plowing and cultivating the soil in an old orchard will also stimulate a rapid growth of all parts of the trees.

The treatment of trees injured by the tree cricket is practically the same as that for cicada injuries, except that the twig and larger branches bearing numerous old, unhealed scars should be cut out, and the unhealed scars on the remaining branches should be filled with hard soap or grafting wax, to prevent the attack of the woolly aphis. The trees should be examined each year, before the leaves start in the spring, and all scars which fail to heal and are infested with the aphis, should be cut out or treated with soap or wax.

SUMMARY.

The so-called seventeen year locust is a cicada, and not a locust, and its proper, common name is *Periodical Cicada*.

The true locust belongs to a class of insects commonly known as grasshoppers, of which the *Rocky Mountain locust*, or western grasshoppers and the Egyptian locust of biblical history, are examples.

The *cicada* belongs to a class of insects related to the true bugs, all of which take their food through a piercing beak, instead of by means of biting mandibles, as do the true locusts.

There are many different kinds or species of insects belonging to the genus cicada, found in different parts of the world. The common dog-day cicada, or so-called "jar fly" or "harvest fly," which appears every year in July and August, is a familiar example which differs in size, color, and habits from the periodical cicada.

The periodical cicada appears to occur only in the United States. It passes a long period of its existence in the ground, coming out in May and June and changing to the adult or winged form at regular intervals of seventeen and thirteen years. Those that come out in periods of seventeen years are designated as the seventeen year race, and occur only in the northern part of the United States. Those that appear in periods of thirteen years are designated as the thirteen year race, and occur only in the southern part of the United States.

There are many so-called *broods* of both the seventeen year and thirteen year races, swarms of which appear in different years, and nearly every year somewhere in the United States.

There are two varieties as well as two races of the species, one large and the other small. The large variety predominates in the swarms of both races.

The peculiar shrill note of the cicada is produced by the males. The females are voiceless.

The adult female is provided with a strong, horny ovipositor with which she makes rows of ragged wounds in the living twigs, branches, and stems of trees and shrubs in which her eggs are deposited. This often results in serious injury to young orchards, nursery stock, shade trees, and ornamental shrubs, also to old apple and pear trees.

With a knowledge of the years in which the swarms are due to appear, and the area occupied by each swarm, almost all losses from injuries to young fruit and ornamental trees may be prevented by planting the trees two or three years before or the year after the swarm appears.

In West Virginia eight broods have been recorded, five of which are known to appear in destructive swarms. Each brood

occupies a separate section of the State, except where they join and overlap.

Swarms of each brood appear at regular intervals of seventeen years, hence all belong to the seventeen year race. The thirteen year race has never been recorded authentically in West Virginia.

The years in which the swarms of the different broods are due to appear in their respective sections of the State are :

1898,	brood XVII.
1900,	" XX.
1901,	" XXI.
1902,	" XXII.
1905,	" V.
1906,	" VIII.
1910,	" XI.
1914,	" XV.

The counties in which swarms of the brood may be looked for are as follows :

The 1898 swarm of brood XVII should be looked for in *Hancock, Brooke, Ohio*, and *Marshall* (?); may not occur in sufficient numbers to attract attention.

The 1900 swarm of brood XX may be looked for in *Hancock, Brooke* (?), *Ohio* (?), *Marshall* (?), and *Wetzel* (?). May not occur in destructive numbers.

The 1901 swarm of brood XXI may be looked for in *Raleigh, Fayette, Summers, Mercer, Monroe, Greenbrier, Pocahontas, Randolph, Tucker* (?), *Preston* (?), *McDowell* (?), *Wyoming* (?), *Logan* (?), *Boone* (?), *Kanawha* (?), *Nicholas* (?). May be expected in destructive numbers in some localities.

The 1902 swarm of brood XXII may be looked for in *Jettersen, Berkeley, Morgan, Hampshire, Mineral, Hardy, Grant, Preston* (?), *Pendleton* (?), *Pocahontas* (?). Will doubtless appear in very destructive numbers in certain localities.

1905 swarm of brood V may be looked for in *Putnam, Lincoln* (?), *Kanawha* (?), *Mason* (?), and *Cabell* (?), and will probably appear in destructive numbers.

The 1906 swarm of brood VIII may be looked for in the counties of *Mason, Cabell, Putnam, Lincoln, Wayne, Boone(?)*, *Logan(?)*, *Mingo(?)*, *Wyoming(?)*, *McDowell(?)*, *Raleigh(?)*, *Fayette(?)*, *Kanawha(?)*, *Jackson(?)*. This will be in all probability a very destructive swarm.

The 1910 swarm of brood XI may be looked for in the counties of *Pendleton, Hardy, Grant, Randolph, Pocahontas(?)*, *Greenbrier(?)*, *Monroe(?)*, *Wayne(?)*, *Mingo(?)*.

The 1914 swarm of brood XV may be looked for in the counties of *Barbour, Brooke, Braxton, Clay, Calhoun, Doddridge, Fayette, Gilmer, Grant, Hancock, Hardy, Harrison, Jackson, Kanawha, Lewis, Marion, Marshall, Mason, Mineral, Monongalia, Nicholas, Ohio, Preston, Putnam, Pocahontas, Pleasants, Roane, Randolph, Ritchie, Taylor, Tyler, Tucker, Upshur, Wetzel, Wirt, Wood, Webster, Wayne(?)*, *Summers(?)*, *Boone(?)*, and *Greenbrier(?)*. This is the largest swarm and will doubtless occur in destructive numbers in certain localities.

The first general appearance of a swarm will vary from the 10th of May to the 15th of June, owing to difference in seasons, latitude and elevation. There appears to be a difference of $3\frac{1}{2}$ days in first general appearance for each difference of 1° F in normal or average summer temperature.

The species appears to be confined in its distribution to the upper austral and transition life zone areas, and probably does not occur in the *Canadian zone*, which in West Virginia, is at and above an elevation of 3,000 feet above the sea.

A few individuals of a swarm may appear one and even two years before the regular time. A few may come out in the fall of the 16th year, and some stragglers may appear in the spring or fall of the 18th year, but the swarm of each brood appear at regular intervals of 17 years.

The English sparrow is one of the worst enemies of the periodical cicada, and appears to be exterminating it in the neighborhood of towns and cities.

Hogs root the young forms out of the ground in the Spring of

the 16th and 17th years, and where the insects are abundant, fatten on them.

Poultry destroy immense numbers of the young as they come from the ground and the immature adults as they cling to the trunks of trees, weed stems, etc.

Squirrels are said to fatten on the adults.

Numerous predatory and parasitic insects prey on the eggs, young and adults.

Contagious diseases often take the character of an epidemic and apparently exterminate the insect, over large areas.

HOW TO AVOID LOSSES FROM CICADA INJURIES TO FRUIT AND OTHER TREES.

Before purchasing trees or shrubs for planting, consult the cicada map, and if there is a possibility of a swarm of the cicada appearing in your county within the next two years, ascertain if it was common in the locality where the trees are to be planted, or if the land was in woods, sprouts, or briers during the last cicada year. IF SO, PUT OFF PLANTING UNTIL THE FALL OR SPRING AFTER THE SWARM IS DUE.

Never plant orchards in the fall previous to a cicada year, or in the spring of the year the cicada is due to appear in the locality.

If planting has already been done and the cicada makes its appearance in threatening numbers, it may be practicable to protect a limited number of small trees and shrubs by covering the tops with thin muslin, or mosquito netting during the first three weeks in June.

If all of the above precautions have been neglected, and young or old trees are severely injured, cut out all severely injured branches, or in case of the trunks of young fruit trees being badly wounded and the tree does not die before fall, cut it off just above the point where the tree is budded or grafted, so that new and vigorous sprouts may be started.

TO OUR READERS.

If our readers will kindly report all appearances of the periodical cicada in the vicinity of their respective postoffices, in any year between and including 1898 and 1914, it will enable the entomologist to prepare and publish accurate maps, showing the distribution of each brood, which will be of special value to the fruit growers.

NOTICE.

Application for bulletins of this Station should be addressed to the Director of the West Virginia Agricultural Experiment Station, Morgantown, W. Va.

(The bulletins named below are available for distribution.)

- No. 4. The Creamery Industry; Its Adaptability to West Virginia.
- No. 5. The Selection of Milch Cows.
- No. 6. Six Months' Experience in Running a Creamery; Improved Process of Handling Cream and Churning.
- No. 12. The Canada Thistle.
- No. 14. Farm and Garden Insects and Experiments with Remedies; Notes of the Season.
- No. 15. Raspberry Gouty-Gall Beetle.
- No. 16. Yellow Locust, Insect Ravages upon.
- No. 17. Black Spruce, Insect Ravages.
- No. 19. Your Weeds and Your Neighbor's, Part 1. Weeds as Fertilizers.
- No. 20. Potato Culture and Fertilization. Tests of Some Varieties of Tomatoes.
- No. 21. Injurious Insects and Plant Diseases.
- No. 25. Plat Experiments with Commerical Fertilizers on Wheat.
- No. 26. Inspection of Commercial Fertilizers.
- No. 27. Notes on Pruning.
- No. 28. Plat Experiments with Commercial Fertilizers on Corn.
- No. 29. Experiments with Potatoes at the Station. Experiments on Corn at the Out-Stations.
- No. 30. Address and Notes on Sheep.
- No. 33. Sub-Irrigation in the Greenhouse.
- No. 38. Potato Blight, Potato Scab.
- No. 40. Commercial Fertilizers.
- No. 42. Vegetables.
- No. 43. When, Why, What and How to Spray.
- No. 44. Practical Entomology.
- Special Bulletin No. 2. Proceedings connected with the celebration upon the completion of the Station Building and the organization of the Sheepbreeders and Wool-growers' Association and the State Horticultural Society.
- Third Annual Report, 1890.
- No. 50. The Periodical Cicada in West Virginia.

